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April 15, 1997

BY HAND

Mr. William Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W.
Washington, DC 20554

Re: Apple Computer, Inc.
ET Docket No. 96-102

Dear Mr. Caton:

On April 14, 1997, Apple Computer, Inc. ("Apple"), filed the attached Reply Comments in ET Docket No. 96-102. Apple hereby resubmits the pleading, to include a Table of Contents, title page, and summary and to correct certain typographical errors. Apple asks that the Commission associate this new material with the above-referenced docket.

Questions with respect to this matter should be directed to the undersigned.

Respectfully submitted,

Henry Goldberg
Attorney for
Apple Computer, Inc.

Enclosure

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	DOCKET FILE COPY ORIGINAL
	)	
Amendment of the Commission's Rules to	)	ET Docket No. 96-102
Provide for Operation of Unlicensed NII	)	RM-8648
Devices in the 5 GHz Frequency Range	)	RM-8653

REPLY COMMENTS OF APPLE COMPUTER, INC.

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April 14, 1997

TABLE OF CONTENTS

SUMMARY i

I. BACKGROUND 1

II. THE COMMISSION SHOULD GRANT APPLE'S REQUEST TO PERMIT U-NII DEVICES TO EMPLOY MORE HIGHLY DIRECTIONAL TRANSMIT ANTENNAS 3

III. THE COMMISSION SHOULD GRANT APPLE'S PROPOSED MODIFICATION TO THE U-NII PSD LIMITS 6

IV. THE COMMISSION SHOULD GRANT WINFORUM'S REQUEST TO MODIFY THE OUT-OF-BAND EMISSIONS LIMITS FOR U-NII DEVICES OPERATING IN THE 5725-5825 MHZ BAND 8

CONCLUSION 10

SUMMARY

The Commission's recently adopted Report and Order in its spread spectrum rulemaking removed all limits on the use of directional transmit antennas by fixed, point-to-point spread spectrum systems operating in the 5800 MHz band. This action supports a grant of Apple's Petition for Reconsideration, which urged the Commission promptly to remove all limits on the use of directional transmit antennas by fixed, point-to-point U-NII devices operating in the 5725-5825 MHz band and permit the use of more highly directional antennas by U-NII devices operating in the 5250-5350 MHz band.

The Report and Order also suggests an approach for regulating U-NII peak PSD. By adopting the same PSD limits for U-NII devices as were adopted for spread spectrum devices, the Commission could enhance the capabilities of U-NII devices and create technical parity among different types of unlicensed devices operating in the 5 GHz band, without creating any additional risk of interference to other users of this band.

In light of the Report and Order, and for the reasons discussed herein, Apple requests that the Commission reconsider and amend the U-NII rules as follows:

- First, the Commission should eliminate the transmitter output power penalty for fixed, point-to-point U-NII devices operating with high gain directional transmit antennas in the 5725-5825 MHz band.

- Second, the Commission should permit fixed, point-to-point U-NII transmitters in the 5250-5350 MHz band to employ directional antennas without limit, subject to a requirement that they decrease transmitter output power by 1 dB for every 3 dB that the antenna gain exceeds 6 dBi.

- Finally, the Commission should adopt the same PSD limits for U-NII devices operating in the 5250-5350 MHz and 5725-5825 MHz sub-bands as were adopted for direct sequence spread spectrum systems: *i.e.*, 8 dBm in any 3 kHz band, with a minimum bandwidth of 500 kHz for maximum-power transmission.

In addition, Apple urges the Commission to grant WINForum's request to modify the out-of-band emission limits for U-NII devices operating in the 5725-5825 MHz band.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of the Commission's Rules to	)	ET Docket No. 96-102
Provide for Operation of Unlicensed NII	)	RM-8648
Devices in the 5 GHz Frequency Range	)	RM-8653

REPLY COMMENTS OF APPLE COMPUTER, INC.

Apple Computer, Inc. ("Apple") hereby responds to the oppositions to Apple's Petition for Reconsideration of the Commission's recent Report and Order in the above-referenced proceeding (the "U-NII Report and Order").[1] In addition, Apple responds to certain comments opposing, in part, the petition for reconsideration filed by WINForum.

I. BACKGROUND

In its Petition for Reconsideration (the "Petition"), Apple asked the Commission to amend the rules governing the operation of Unlicensed National Information Infrastructure ("U-NII") devices in three respects:

- First, Apple urged the Commission promptly to consider permitting U-NII transmitters operating in the uppermost portion of the U-NII band (5725-5825 MHz) to use more highly directional antennas, and to consider this issue at the same time as it considered whether to permit spread spectrum systems operating in the same band to use more highly directional antennas.[2]

- Second, Apple requested that the Commission amend the antenna directionality rules for the middle portion of the U-NII band (5250-5350 MHz).

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[1] Amendment of the Commission's Rules to Provide for Operation of Unlicensed NII Devices in the 5 GHz Frequency Range, Report and Order, ET Docket No. 96-102, FCC 97-5 (released Jan. 9, 1997).

[2] Amendment of Parts 2 and 15 of the Commission's Rules Regarding Spread Spectrum Transmitters, ET Docket No. 96-8 (the "spread spectrum rulemaking").

- Third, Apple requested that the Commission amend the peak power spectral density ("PSD") limits for U-NII devices operating in the 5250-5350 MHz sub-band and the 5725-5825 MHz sub-band.

After Apple's Petition and responsive comments were filed, the Commission adopted a Report and Order in its spread spectrum rulemaking (the "Spread Spectrum Report and Order").[3] In this decision, the Commission removed all limits on the use of directional transmit antennas by fixed, point-to-point spread spectrum systems operating in the 5800 MHz band.[4]

The Spread Spectrum Report and Order thus moots one aspect of Apple's Petition — *i.e.*, Apple's request that the Commission consider in tandem, rather than sequentially, whether to permit U-NII and spread spectrum systems to use more highly directional antennas. As discussed below, however, its reasoning supports an immediate grant of Apple's underlying request — *i.e.*, that the Commission promptly remove all limits on the use of directional transmit antennas by fixed, point-to-point U-NII devices operating in the 5725-5825 MHz band and permit the use of more highly directional antennas by U-NII devices operating in the 5250-5350 MHz band.

The Spread Spectrum Report and Order also suggests an approach for regulating U-NII peak PSD. By adopting the same PSD limits for U-NII devices as were adopted for spread spectrum devices, the Commission could enhance the capabilities of U-NII devices and create technical parity among different types of unlicensed devices operating in the 5 GHz band, without creating any additional risk of interference to other users of this band. Thus, even were the Commission to credit the objections to Apple's Petition — which, for the reasons discussed below it should not — the Commission could modify the U-NII PSD limit in a manner acceptable to Apple.

In light of the Spread Spectrum Report and Order, and for the reasons discussed herein, Apple thus requests that the Commission amend the U-NII rules as follows:

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[3] Amendment of Parts 2 and 15 of the Commission's Rules Regarding Spread Spectrum Transmitters, Report and Order, ET Docket No. 96-8, FCC 97-114 (released Apr. 10, 1997).

[4] Id. at ¶¶ 1, 11-12.

- First, the Commission should eliminate the transmitter output power penalty for fixed, point-to-point U-NII devices operating with high gain directional transmit antennas in the 5725-5825 MHz band.

- Second, the Commission should permit fixed, point-to-point U-NII transmitters in the 5250-5350 MHz band to employ directional antennas without limit, subject to a requirement that they decrease transmitter output power by 1 dB for every 3 dB that the antenna gain exceeds 6 dBi.

- Finally, the Commission should adopt the same PSD limits for U-NII devices operating in the 5250-5350 MHz and 5725-5825 MHz sub-bands as were adopted for direct sequence spread spectrum systems: *i.e.*, 8 dBm in any 3 kHz band, with a minimum bandwidth of 500 kHz for maximum-power transmission.

In addition, Apple urges the Commission to grant WINForum's request to modify the out-of-band emission limits for U-NII devices operating in the 5725-5825 MHz band.

II. THE COMMISSION SHOULD GRANT APPLE'S REQUEST TO PERMIT U-NII DEVICES TO EMPLOY MORE HIGHLY DIRECTIONAL TRANSMIT ANTENNAS.

The Commission's recent Spread Spectrum Report and Order confirms the premises underlying Apple's request to permit U-NII devices to employ more highly directional transmit antennas, without paying a power penalty. It recognizes the benefits of longer-distance unlicensed operation, which enables users to establish radio links without the delays and costs associated with formal frequency coordination and licensing.[5] It recognizes that directional antennas "can significantly reduce the potential for harmful interference to other radio operations," particularly where the location of the directional system is coordinated and there is a low preponderance of mobile systems.[6] It recognizes that the use of directional antennas will help transmission systems to overcome high background noise levels, permitting their use by important communication services.[7] Finally, it recognizes that the 5.8 GHz band is uniquely well-suited to the operation of directional antennas, primarily due to the relatively few number of users, particularly mobile users, operating in the

---

[5] Spread Spectrum Report and Order at ¶¶ 1, 11.

[6] Id. at ¶ 11.

[7] Id. at ¶ 12. This benefit of directional antennas is particularly important for the 5.8 GHz band, due to the rising levels of background noise in that band.

band and, thus, the limited potential for harmful interference arising from the use of high gain directional antennas.[8]

Each of the reasons underlying the Commission's decision to permit spread spectrum systems to employ more highly directional antennas applies equally forcefully to U-NII systems. Indeed, Apple's proposal to conform the PSD limits for spread and non-spread systems, discussed in the following section, would render U-NII transmitters indistinguishable from spread spectrum transmitters from the point of view of an unassociated receiver. As a result, the Commission promptly should equalize the rules for U-NII and spread spectrum systems operating in the 5725-5825 MHz band.

The middle U-NII band (5250-5350 MHz) presents a different sharing environment from the upper U-NII band. In contrast to the upper band, "(t)he only operations in this band are Government radiolocation systems (radar)."[9] While limited in scope, these operations are very important. The relatively more restrictive rules adopted for the 2400 MHz "spread spectrum" band are, therefore warranted, for the middle U-NII band.

None of the objections to Apple's request justifies continuing to regulate U-NII devices more rigidly than spread spectrum devices. AT&T's claim that the use of more highly directional antennas would allow U-NII devices to cause harmful interference to primary users ignores the arguments, credited in the Spread Spectrum Report and Order, favoring directionality as a means of reducing, not increasing, interference (as well as maximizing spectrum efficiency).

The objections of the American Radio Relay League, Incorporated ("ARRL") reflect the League's general opposition to any shared use of Amateur Radio Service frequencies, rather than the presence of any real threat to Amateur Service operations posed by Apple's proposal. ARRL has never indicated that interference will occur, or even provided information concerning the current and planned Amateur Service use of the 5.8 GHz band. Instead, it has demanded that Apple produce proof that there is no possibility that interference will occur — in other words, that Apple prove a negative. Most importantly, ARRL has failed to demonstrate that non-spread U-NII

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[8] Id. at ¶ 7.

[9] U-NII Report and Order at ¶ 45.

transmitters using highly directional antennas pose any greater threat of interference to Amateur Service operations than do spread spectrum transmitters using highly directional antennas.[10] In light of the Commission's Spread Spectrum Report and Order and its commitment to let the marketplace rather than regulations decide which technologies will succeed and which will fail, ARRL must be required to make such a showing if they are urging the Commission to deny Apple's request.[11]

Finally, AT&T's assertion that a grant of Apple's petition would be inconsistent with principles of regulatory parity also ignores both logic and the express decision of the Commission in the U-NII Report and Order.[12] The U-NII Report and Order rejects the claim that regulatory parity requires the licensing of all longer-distance links.[13] As Apple previously has discussed at length, and as the Commission recognized, unlicensed Part 15 systems are fundamentally different from licensed systems. Most importantly, unlicensed systems operate in an "at sufferance" mode and, therefore, cannot assure the quality of service that telecommunications service providers can offer when using exclusively licensed and protected spectrum. Rather than restrict consumers' options in order to protect the "investment" of auction winners, as AT&T suggests, the Commission should stand by its decision to permit the development of longer-distance unlicensed systems.

For the foregoing reasons, Apple urges the Commission to treat U-NII directional antennas similarly to spread spectrum directional antennas. Thus, in the

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[10] ARRL also has failed to document any case in which spread spectrum transmitters, including those operating lawfully or unlawfully at much higher powers than have been proposed by Apple and endorsed by the Commission for U-NII devices, have interfered with an Amateur Service operator utilizing the 5800 MHz band.

[11] Apple also notes that the Commission's decision not to permit higher gain U-NII antennas was based on concerns about potential interference to Government radiolocation stations, not to Amateur Service stations. U-NII Report and Order at ¶ 46. NTIA, however, has not objected to Apple's Petition. Moreover, while NTIA's concerns about interference to radiolocation applied equally to spread spectrum and U-NII devices, NTIA Reply Comments at 9-10 (filed August 16, 1996), the Commission already has authorized higher gain spread spectrum systems.

[12] AT&T Opposition at 2-3.

[13] U-NII Report and Order at 88 ("We also are unpersuaded by the arguments that U-NII devices and associated operations need to be licensed in order to provide regulatory parity with licensed services."); see also Spread Spectrum Report and Order at ¶ 1 (discussing the benefits of longer-distance unlicensed operation and implicitly rejecting any "regulatory parity" issue, even when unlicensed links are used for Internet connections, PCS and cellular backbone connections, and T-1 common carrier links). Notably, AT&T Wireless Services supported the Commission's proposal to permit longer-distance operations by Part 15 spread spectrum devices. Id. at ¶ 8. There is no principled basis upon which the Commission could conclude that longer-distance U-NII systems raise regulatory parity issues, while longer-distance spread spectrum systems do not.

lower U-NII band (5150-5250 MHz) the present rule should stand, and transmit power should be reduced dB for dB to account for transmit antenna gains greater than 6 dBi. In the middle U-NII band (5250-5350 MHz), systems used exclusively for fixed, point-to-point operations should be permitted to employ transmitting antennas with directional gain greater than 6 dBi but transmitter power should be reduced 1 dB for every 3 dB that the directional gain of the transmitting antenna exceeds 6 dBi. Finally, in the upper U-NII band (5725-5825 MHz), systems used exclusively for fixed, point-to-point operations should be permitted to employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter power. The operation of high gain antenna U-NII systems in the middle and upper bands would be subject to the same limitations as apply to high gain antenna spread spectrum systems.[14]

III. THE COMMISSION SHOULD GRANT APPLE'S PROPOSED MODIFICATION TO THE U-NII PSD LIMITS.

In its petition, Apple asked the Commission to amend its U-NII peak PSD rules so as to make it more feasible for U-NII links in the middle and upper portions of the U-NII band to support T1 and faster data rates over distances exceeding several kilometers. This request was made in conjunction with Apple's request for removal or reduction of antenna gain penalties, discussed in the previous section.

Just as the determinations regarding antenna gain that were made in the Spread Spectrum Report and Order offer a usable model for the U-NII band, so too the PSD limits could be reflected in the U-NII rules, to the benefit of users. Apple suggests that most of its objectives for the U-NII band would be served by applying the same limits to non-spread emissions as are applied for direct sequence systems, *i.e.*, 8 dBm in any 3 kHz band with a minimum bandwidth of 500 kHz for maximum-power transmission.

Direct sequence systems are favored for some applications because they present a lower interference level to non-related receivers. In other applications (particularly indoors), the ability of direct sequence systems to overcome some degree of multipath offers a reason to choose that modulation scheme. In still other scenarios, the ability of direct sequence systems to resist interference (as a function of processing gain or jamming margin) is the most important consideration.

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[14] See Spread Spectrum Report and Order at ¶¶ 19, 21.

Direct sequence systems, however, present tradeoffs. Obviously, to attain the benefits described above, desired-signal information must be "artificially" spread over a wider RF band. As a result, the maximum data rate that can be delivered will be only a fraction of the capacity of the band, while associated receivers are open to interference that appears anywhere in that band. The high pseudorandom "chip" rate does not itself carry message information.

By comparison, in a non-spread system, there is no transmission of non-traffic bearing signals. As a result, higher data rates can be transmitted within any given slice of spectrum. In addition, the cost and complexity of non-spread receivers compared with direct sequence receivers can be lower; this will remain true until the cost (and power consumption) of digital signal processing decreases. Moreover, some outdoor point-to-point links may not require as much multipath mitigation as, *e.g.*, in-building high data rate LANs, and thus one of the benefits of direct sequence systems may not be as important for these outdoor systems.

The tradeoffs between spread and non-spread systems are complex, and different users and applications will benefit from each. Inasmuch as one of the primary goals of the U-NII band is to offer higher data rates, Apple's proposal for parity of PSD with direct sequence systems would offer designers and users much greater flexibility, creating an enlarged set of tradeoffs and technical means for addressing any particular requirement. It would do so with very little or no disadvantage to other users, because non-associated receivers would see the same interference level from all systems of the same PSD, whether spread or non-spread.[15]

Apple, therefore, recommends that the Commission modify the PSD limit for U-NII devices operating in the 5725-5825 MHz band from 1 Watt in 20 MHz (50 mW/MHz) to 8 dBm in any 3 kHz band. It should also modify the PSD limit for U-NII band devices operating in the 5250-5350 MHz band, only with a maximum power of 0.250 Watts. These changes will significantly improve the ability to use the U-NII band for Community Networks, and will create some degree of technological and distance-reaching parity between U-NII devices and spread spectrum devices while offering the potential, in some circumstances, for higher data rates.

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[15] While it is true that non-spread receivers may not be able to resist interference as well as spread spectrum receivers, individual consumers should be free to accept this limitation in return for the higher data rates possible with a non-spread system.

The only opposition to Apple's proposal to modify the PSD limits for the middle and upper U-NII bands is based on a faulty premise and should be disregarded. AirTouch Communications, Inc. ("AirTouch") incorrectly assumes that Apple's proposal to modify the U-NII PSD limits for the 5250-5350 MHz band "will necessarily increase the out-of-band emissions from ...U-NII devices into the adjacent 5.15-5.25 GHz band."[16]

In-band and out-of-band emissions, however, are not necessarily related. Out-of-band emissions can be affected by filtering, by choice of modulation schemes, by component hardware, and many such causes other than simply in-band power or PSD. Moreover, the out-of-band emission rules would limit out-of-band emissions from U-NII devices to levels that are three to four orders of magnitude lower than the levels AirTouch is prepared to accept from in-band emitters.[17] For both of these reasons, the Commission should disregard AirTouch's assertion that Apple's proposed PSD modification will adversely affect MSS feeder link operations.[18]

IV. THE COMMISSION SHOULD GRANT WINFORUM'S REQUEST TO MODIFY THE OUT-OF-BAND EMISSIONS LIMITS FOR U-NII DEVICES OPERATING IN THE 5725-5825 MHZ BAND.

Resound Corporation ("Resound") opposes WINForum's request to modify the limits governing out-of-band emissions into the 5825-5850 MHz band, which is adjacent to the uppermost U-NII sub-band. For both technical and legal reasons, this opposition should be rejected and WINForum's request should be granted.

As a technical matter, contrary to Resound's assertions, "spill-over" (sic) from U-NII band devices will be deeply suppressed at WINForum's proposed limits. Imposition of an arbitrary additional 10 dB suppression in the 25 MHz that lies between the U-NII band and the low-power-device (Section 15.249) band represents technical over-kill that would adversely affect product costs without providing compensatory benefits.

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16 AirTouch Opposition at 6-7.

17 Interference to users of adjacent bands could be further mitigated by expressing out-of-band emission limits as a reasonable absolute level, rather than through a reference to actual in-band power used. WINForum has proposed such a modification, WINForum Petition for Reconsideration and Clarification at 10, and Apple supports this proposal.

18 Notably, none of the other MSS proponents — L/Q Licensee, Inc., ICO Global Communications, and COMSAT Corporation — objected to Apple's proposed PSD modification.

As a legal matter, Resound overstates the extent to which Section 15.249 devices are entitled to be protected from unwanted emissions. While Apple supports efforts to ensure the continued reliable operation of Section 15.249 devices, it is not true, as Resound appears to believe, that Section 15.249 devices are "protect[ed]" from interference and that the Commission should refrain from adopting any rule that "would have the potential" to cause interference to these devices.[19] Like other Part 15 devices, Section 15.249 devices operate in a shared spectrum environment, and must accept the limitations inherent in unlicensed operation.

As was true with respect to AirTouch's concerns, Resound's concerns will be addressed, and Section 15.249 devices will not suffer objectionable interference from U-NII devices, if out-of-band emission limits are expressed as reasonable absolute levels, rather than as levels referenced to actual transmitted in-band power.[20] WINForum has proposed such a solution, and Apple supports WINForum's proposal.

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19 Resound Opposition at 2, 3.

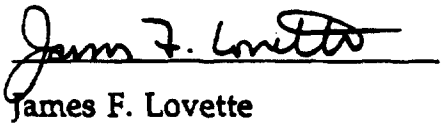
20 See n. 16, supra.

CONCLUSION

For the reasons stated herein, Apple respectfully requests that the FCC promptly consider whether to permit the use of more highly directional antennas by U-NII devices operating in the middle and upper U-NII sub-bands, amend the peak PSD limits for U-NII devices operating in these sub-bands, and grant those portions of WINForum's Petition discussed herein.

Respectfully submitted,

APPLE COMPUTER, INC.



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April 14, 1997

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing Errata was sent by first-class mail, postage prepaid, this 15th day of April, 1997, to each of the following:

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